GENERAL ELECTRIC

TCM-2
TYPICAL TYPE TEST

WGLAEL

BURBANK, CAL.

STANLEY E. HYDE
444 W. VALENCIA AVE.
BURBANK, CALIF.

TYPICAL TYPE TEST

MODEL TCM-2 H. F.

TRANSMITTING EQUIPMENT

Frequency Range:
2000 - 18,000 KC

Manufactured By
GENERAL ELECTRIC COMPANY
Bridgeport, Conn.

for

U. S. NAVY DEPARTMENT

CONTRACT NXSS 15910

U.S. NAVY CONTRACT #NXSS 15910

TEST #1

(a) General Inspection & Continuity Check — Satisfactory

(b) Determine adequacy of features incorporated for protection of personnel — Satisfactory

(c) Determine adequacy of features incorporated for protection of tubes and equipment. Check Interlocks and Fuses. — Satisfactory

Determination of power required from Supply Line.
Specifications: CW key locked (full power) shall not exceed 1.4 KW. Use 115V - 60 Cycle.

Transmitter Frequency 2500 KC

(d) Power Required for starting (key open plate voltage off) — .250 K.W.

(e) Power required for standby (key open plate voltage on) — .460 K.W.

(f) Power required MCW key locked with modulation on — .840 K.W.

(g) Power required Phone key locked without modulation — .860 K.W.

(h) Power required for CW key locked — 1.1 K.W.

(i) P.A. Plate current 320 M.A. - Power Output 265 watts.

Signed D. S. Kearney

Date 9-17-43

TEST #2

Determination of Operation for Line Voltage Variation.

Specifications: Satisfactory operation over range of -15% to +10% (97.75 to 128.5 volts) and 60 cycles. CW output of 150 W. Phone output of 37.5 W. 6.3V filament voltages within 2% of rating. PA filaments within 5%.

Output Frequency 2500 KC: Power Tap 3.

Fil. Voltage (Trans. Meter Check) 6.4 Volts

Fil. Voltage P.A. 9.6 Volts

Percent from Normal	-15.6	-10.4	-4.4	0	+4.3	+10.4
Power Input Rect.Watts CW	970	1040	1030	1000	960	1030
Main Plate Voltage	1170	1250	1250	1225	1200	1250
Aux. Plate Voltage	420	450	450	450	450	450
Line Tap	4	4	3	2	1	1
Fil. Tap	4	4	3	3	2	1
Power Output CW	240	240	235	230	225	235
Power Output Phone	45	55	55	52	50	52

Signed: D. S. Kearney

Date: 9-17-43

TEST #3

Determination of frequency range and overlap.

The percent overlap is $\frac{\text{KC overlap} \times 100}{\text{Mean Freq. in KC}}$

M.O.Frequency Range

Nominal 1000 to 2262.5 KC

Band	Dial	Freq. KC	Overlap in KC	Mean Freq.	Percent Overlap
1	0	924	75	1000	7.6%
1	2500	1236	89	1191	7.5%
2	0	1147			
2	2500	1530	114	1437	7.75%
3	0	1416			
3	2500	1892	149	1817.5	8.2%
4	0	1743			
4	2500	2327	64.5	2262.5	2.85%

Specs: Min. 5% between bands.

Signed: Frank Ferenczi

DATE: 9-15-43

U.S. NAVY CONTRACT #NXSS 15910

TEST #4 Determination of Power Output

Output Freq. KC		2000	2500	3000	5000	6000	18,000
M.O. Freq. KC		2000	2500	3000	5000	6000	18,000
M.O. Band	A	1	2	3	2	3	4
M.O. Dial	B	811	994	587	882	610	2,200
M.O. Plate Current M.A.		15	17	20	17	16	22.3
1st I.P.A. Band	C	1	1	1	2	3	3
1st I.P.A. Dial	D	36	70	85	83.5	48	91
1st I.P.A. Plate Current		15	12	10	16	20	15
P.A. Band	E	1	1	2	2	3	3
2nd I.P.A. Dial	F	427	1652	1658	1466	113	1802
2nd I.P.A. Plate Current M.A.		62	40	56	49	40	36
P. A. Dial	G	43	1459	587	1218	834	1653
P.A. Plate Current MA.		300	300	300	280	265	280
Output Tuning Cap.	H	41	51	51	92.5	99.5	90
Output Tuning Ind.	J	1158	1143	2100	847	2054	3332
Ant. Tuning Cap.	K	100	100	100	100	85	0
Ant. Tuning Ind.	L	466	339	881	0	1894	3156
Ant. Current Amps.		2.2	2.3	2.3	2	205	1.8
Power Output CW Watts		266	290	290	220	230	180
Required Power Output		150	150	150	148	144	100
Required Output phone watts		37.5	37.5	37.5	37.0	36.0	25
Power output phone watts		58	55	60	50	50	50
MCW (1000 cycle modulation) Percent Mod.		88%	86	90	85	83	81
Specified Mod. Percentage is 80% at 25% of the required CW output							
Filament Tap		2	2	2	2	2	2
Line Input Voltage, (normal) (115V)		115	115	115	115	115	115
Main Plate Voltage		1270	1275	1250	1300	1300	1270
Aux. Plate Voltage		450	460	450	475	475	475
Line Tap		2	2	2	2	2	2
Power Tap		3	3	3	3	3	3

Signed: F. E. Ferenczi

Date: 9-18-43

TEST #5

Determination of Audio Fidelity

Specification Limit is ± 2 DB from 200 to 3000 cycles.

Measured at 2500 KC with transmitter fully loaded on CW

Phone carrier 55 Watts.

Required carrier 37.5 watts.

Audio Input to line input on transmitter .55 volts

Adjust audio gain control for 90% modulation of 1,000 cps.

Mod. Freq. Cycles	Transmitter Mod. Meter	Test Mod. Meter Mod. Percentage	DB
100	32	57	-3.9
200	50	78	-1.2
500	57	85	- .5
1000	62	90	0
1500	60	88	- .16
2000	52	82	- .8
3000	40	73	-1.8
4000	33	62	-3.2

Calculate Fidelity From

% Modulation as Follows:

$$DB = 20 \log \frac{\% \text{ Mod. at Mod. Freq.}}{\% \text{ Mod. at Ref. Freq.}}$$

Signed: R. H. Misner

Date: 9-24-43

TEST #5 Cont.

Determination of Audio Distortion

Specifications require 12% R.M.S. distortion or less when modulated 80%. Use 400 cycle audio frequency.

Output R.F. KC	Carrier Output W.	Percent Dist. R.M.S.	Audio Volts Input
2000	55	10%	55
4000	55	8.3%	55
8000	55	7.6%	55

Wave shape satisfactory.

Signed: F. Allen Shark

Date: 9-20-43

Determination of NCW Frequency

Specifications require 1000 cycle modulation 10%

Modulation frequency measures 1020 cycles.

Deviation from 1000 cps = 2 %

Signed: R. N. Misner

Date: 9-20-43

TEST #5 Cont.

Determination of microphone modulation and audio gain

Spec. require: Gain control range of +5 to -10 DB at zero level of 6 milliwatts into 500 ohms (line input circuit).

Transmitter adjusted to 2,500 KC for phone operation with

48 watts carrier (1000 cycle modulation).

Audio Input Volts	Audio Level DB	Approx. Pos. Gain Control	Transmitter Modulation Indicator	Percent Mod.
3.08	+5	80 Deg.Open	55	80%
1.75	0	110 Deg.Open	55	80%
.97	-5	150 Deg.Open	55	80%
.547	-10	180 Deg.Open	55	80%

Spec. require: 80 to 90% modulation with microphone.

T-38 or equivalent over audio band 200 to 3000 cycles.

Speaking in a normal tone of voice. 90 Percent modulation is obtained on peaks with the audio gain approximately 150° open when using the Navy model 51004 microphone.

Signed: R. N. Misner

Date: 9-20-43

TEST #6

Determination of lost Motion-Backlash and Torque Lash

Spec. not to exceed ± 0.03%

Trial	M.O. Band	M.O. Dial	Clockwise Freq.	CCW Freq.	Cycles Dev.	Percent
1	2	922	2500.500	150	350	.014
2	2	921	"	800	300	.012
3	2	921	"	650	150	.006
4	2	921	"	730	230	.0092
5	2	921	"	580	80	.0032
				Average	222	.0088

Test to be made at 2500 KC -

Signed: W. L. Chamberlin

Date: 9-25-43

TEST #7

Power Output VS Power Output Control

Power Output Tap	1	2	3
Antenna Current	1.2 amps.	1.7	2.3
% Power	27%	57%	100%
Plate Volts	550	900	1250
Power Output	72 Watts	150	265

Freq. 2,500 KC Antenna & Lamp Load

Spec. Limit 25% minimum in power output on tap 1.

Signed: W. L. Chamberlin

Date: 9-16-43

TEST #8

Determination of Frequency variation due to locked key operation for two hours.

Specified: Two hours, full power key locked, ambient constant between 45°C and 50°C. The frequency shall not vary more than 0.008% at any time during the two hour run as measured after the first 20 minutes of the two hour run. Check at frequencies of 2500 7000, and 16000 KC.

Note: (To expedite testing production tests are made at room temperature and only one frequency (2500KC). Type tests as specified above.

Run at output frequency of 2500 KC M.O. on Band 2 Line volts 115

Antenna:

Time	Amb.Temp.°C	Frequency KC	Cycle Change	% Change	P.A. Plate M.A.	P.A. Plate Volt
2.20	25°C	2500.525			280	1200
2:30	"	450			280	1200
2:40	"	420	105	.0042	285	1200
2:50	"	422	2	.00008	285	1200
3:00	"	422	2	.00008	285	1200
3:10	"	415	5	.0002	285	1200
3:20	"	430	10	.0004	285	1200
3:30	"	430	10	.0004	285	1200
3:40	"	435	35	.0014	285	1200
3:50	"	460	40	.0016	285	1200
4:00	"	475	55	.0022	285	1200
4:10	"	480	60	.0024	285	1200
4:20	"	475	55	.0022	285	1200

Percent Deviation $\frac{\text{KC Max.shift} \times 100}{\text{Freq.in KC}}$ .0024 %

Signed: Frances Moris

Date: 9-20-43

TEST #8

Determination of frequency variation due to locked key operation for two hours,

Specified: Two hours, full power key locked, ambient constant between 45°C and 50°C. The frequency shall not vary more than 0.008% at any time during the two hour run as measured after the first 20 minutes of the two hour run. Check at frequencies of 2500 7000, and 16000 KC.

Note: (To expedite testing production tests are made at room temperature and only one frequency (2500KC). Type tests as specified above.

Run at output frequency of 7000 KC M.O. on Band 3 Line volts 110

Antenna: 200 Watt Lamp Load

Time Hr.Min.	Amb.Temp.°C	FrequencyKC	Cycle Change	% Change	P.A. Plate M.A.	P.A. Plate Volt
0:00	46	7000.950	580	.0083	290	1250
0:10	48	.450	80	.0011	"	"
0:20	48	.370	--	--	"	"
0:30	49	.325	45	.0006	"	"
0:40	50	.320	50	.0007	"	"
0:50	50	.327	43	.0006	"	"
1:00	50	.340	30	.0004	"	"
1:10	46	.415	45	.0006	"	"
1:20	48	.450	80	.0011	"	"
1:30	50	.470	100	.0014	"	"
1:40	46	.503	133	.0018	"	"
1:50	49	.520	150	.0021	"	"
2:00	50	.535	165	.0024	"	"

Percent Deviation = $\frac{\text{KC Max. shift x 100}}{\text{Freq. in KC}}$ = .0024 %

Signed: Frances Moris

Date: 9-29-43

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TEST #8

Determination of frequency variation due to locked key operation for two hours.

Specified: Two hours, full power key locked, ambiant constant between 45°C and 50°C. The frequency shall not vary more than 0.008% at any time during the two hour run as measured after the first 20 minutes of the two hour run. Check at frequencies of 2500 7000, and 16000 KC.

Note: (To expedite testing production tests are made at room temperature and only one frequency (2500KC). Type tests as specified above.

Run at output frequency of 16,000 KC M.O. on Band 4 Line volts 110

Antenna: 200 Watt Lamp Load

Time Hr.Min.	Amb.Temp.°C	Frequency KC	Cycle Change	% Change	P.A. Plate M.A.	P.A. Plate Volt
0:00	48	80000.800	220	.0027	280	250
0:10	50	.730	150	.00188	"	"
0:20	46	.580	--	--	"	"
0:30	46	.530	50	.00062	"	"
0:40	47	.540	40	.00050	"	"
0:50	46	.520	60	.00075	"	"
1:00	46	.491	89	.0011	"	"
1:10	45	.473	107	.00134	"	"
1:20	45	.460	120	.00150	"	"
1:30	48	.458	122	.00152	"	"
1:40	48	.475	105	.00132	"	"
1:50	46	.462	118	.00148	"	"
2:00	50	.462	118	.00148	"	"

Percent Deviation $\frac{\text{KC Max. shift x 100}}{\text{Freq. in KC}}$ .00152 %

Signed: Frances Moris

Date: 9-29-43

TEST #9

Variation in frequency due to changes in Ambient Temp.

Time	Amb.°C	Output Freq.	Cycle Change	%/°C	Line V	Ant. Amps.
6:00	-32	2500.610			110	1.6
0:20	-22	.573	-37			
0:50	-22	.540	-70			
1:20	-22	.440	-170*	.00068		
1:40	-12	.390	-50			
2:10	-12	.285	-155			
2:40	-12	.280	-160*	.00064		
2:50	-2	.230	-50			
3:20	-2	.020	-260			
3:50	-2	2500.055	-225*	.00090		
4:00	+8	2499.880	+175			
4:20	+8	2499.465	-590			
4:30	+8	2499.395	-660			
5:05	+8	2499.120	-935*	.00374		
5:15	+18	2498.925	-195			
5:35	+18	2498.630	-490			
5:55	+18	2498.940	-180			
6:07	+18	2499.440	+320*	.00188		
6:14	+28	.355	-85			
6:20	+28	.135	-305			
6:35	+28	.085	-355			
7:05	+28	.395	-45			
7:35	+28	.520	+80*	.00032		
8:00	+38	.340	-180			
8:10	+38	.435	-85			
8:40	+38	.575	+55*	.00022		
9:10	+48	.483	-92			
9:40	+48	.550	-25			
10:10	+48	2499.715	+140*	.00056	110	1.6

Allow one hour for each temp. take every 10° (-32 to +50)

SPECIFICATION LIMIT: .005% per °C

Signed: M. L. Louner

Date: 9-29-43

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TEST #10

Variation in frequency and power output due to variations in humidity.
(a) Operate 30 min. Key locked, full load, 40 C°, 30% R.H.

(b) Raise R.H. to 95%, operate 1 hr.

(c) Lower R.H. to 30%, operate 1 hr.

Nominal Frequency: 2500KC

Spec: Frequency change max. 0.2%
Spec: Reduction in power 25% max.

Time	Amb. C°	Rel. Hum.	Freq. KC	Ant. Amps.
0:00	41	30	2500.685	1.6
0:15	40	30	.660	
0:30	41	30	.620 "A"	
0:45	42	44	.580	
1:00	42	63	.437	
1:15	42	82	.235	
1:30	43	94	.110	
1:45	43	95	2500.095	
2:00	42	94	2499.965	
2:15	42	95	2499.950	
2:30	42	95	2499.855 "B"	1.6
2:45	45	35	2500.255	1.55
3:00	40	30	.285	
3:15	40	30	.595	
3:30	40	30	.593	
3:45	40	30	.565	
4:00	42	30	2500.575 "C"	1.55

Antenna: 200 Watt Lamp Load

Percent change in frequency (B to C) .0288 %

Percent change in power (B to C) .31 %

Signed: M. L. Louner

Date: 10-28-43

TEST #11

Variation of Freq. due to change of supply line voltage.

Line Voltage	Freq.	% Change
Change in voltage over a period of one minute		
115	2500.000 KC	.00012 %
109	2500.497	---
121	2500.497	0%
Change in voltage over a period of five minutes		
115	2500.500 KC	.00065 %
109	2500.485	---
125	2500.470	.0015 %

Spec. Limits: .0025%

Signed: M. L. Louner

Date: 9-20-43

TEST #12

Variation on frequency due to change from key locked operation to intermittently keyed operation

Test Condition M.O. Filament	Freq. at end of 10 min. Key Locked period	Freq. at end of 10 Sec. Dash 20 min. later	% Change
Lighted	2500.500	2500.555	.0022
Not Lighted	2500.500	2500.665	.0066

SPECIFICATION LIMIT: 0.01% filament on.

SPECIFICATION LIMIT: 0.05% filament off.

Signed: F. Allen Sherk

Date: 9-21-43

TEST #13

To determine frequency variation vs. power output control.

Power output tap	3	2	1
Frequency KC	2500.100	2500.095	2500.110
KC Change	XXXXX	.005	.010
% Freq. Change	XXXXX	.0002	.0004

Specifications: .005% Maximum deviation on Freq.

To determine accuracy of reset.

Specification: ± .08% in less than 1 minute

TEST #14

Trial #	Nominal Freq. KC	Time Sec.	Deviation in Cycles	Freq. %
Original	2500.500kc.			
1	"	50	35	.0014
2	"	45	20	.0008
3	"	50	60	.0024
4	"	60	5	.0002
5	"	40	0	---
	Average	49		.00096

Signed: M. L. Louner

TEST #15

Master oscillator dalibration

Percent freq. change per dial division

Band 1

Freq. KC	Dial
950	306
1000	822
1050	1270
1100	1653
1150	1966
1200	2240

Max. change per div. .0152 %

Band 2

Freq. KC	Dial
1200	485
1250	890
1300	1256
1350	1573
1400	1848
1450	2087
1500	2300

Max. change per div. .0156 %

Band 3

Freq. KC	Dial
1500	693
1550	997
1600	1288
1650	1546
1700	1769
1750	1975
1800	2161
1850	2327
1900	2500

Band 4

Freq. KC	Dial
1850	640
1900	901
1950	1140
2000	1362
2050	1574
2100	1751
2150	1917
2200	2073
2250	2228

SPECIFIDATION LIMIT: .02% per div. max.

Max. change per div. .0154% Max. change per div. .0157 %

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TEST #16
1st IPA frequency Range:
Nominal 2000 KC to 9059 KC

Band	Dial	Freq. KC	Overlap KC	Mean Freq.	% Overlap
1	22	1900.0	100.0	1951.2	5.0
1	94.5	3379.4			
2	25	3214.6	164.8	3297.0	5.0
2	94	5748.0			
3	33	5468.0	280.0	5608.0	5.0
3	94	9308.0*	258.0	9179.0	2.8

Test 3A
2nd I.P.A. Frequency Range
Nominal 2000 to 18,100 KC

Band	Dial	Freq. KC	Overlap KC	Mean Freq.	% Overlap
1	138	1900.0	100.0	1950.0	5.13
1	2000	2648.65			
2	135	2519.35	129.3	2584.0	5.0
2	895	6669.5			
3	1178	6344.5	325.0	6507.0	5.0
3	1824	18616.0 *	516.0	18,358.0	2.8

P.A. Frequency Range

Band	Dial	Freq. KC	Overlap KC	Mean Freq.	% Overlap
1	77.5	1900.0	100.0	1950.0	5.13
1	1363	2648.65			
2	69.5	2519.35	129.3	2584.0	5.0
2	1375	6669.5			
3	478.5	6344.5	325.0	6507.0	5.0
3	1569	18616.0 *	516.0	18,358.0	2.8

Check P.A. overlap with antenna circuit disconnected at blocking capacitor item #236.

SPECIFICATION LIMIT: 5%

Signed: M. L. Rouner

Date: 9-15-43

*Limited by highest frequency of M.O.

TEST #17

Freq. Change VS. Detuning

Adjust for full power output. Detune each stage to give 25% change from resonance in Plate current for the stage controlled.

Measure frequency change

Nominal Frequency 2000 KC. Original Frequency 2500.500 kc.

Circuit Detuned	Frequency Clockwise	Detune Counter Clockwise	Percent Clockwise	Change Counter Clockwise
1st IPA	5	2	.00025	.0001
2nd IPA	2	4	.0001	.0002
PA	10	6	.0005	.0003
Ant "H"	5	2	.00025	.0001

Nominal Frequency 4500 KC, Original Frequency 4500.500 kc.

1st IPA	10	13	.00021	.00026
2nd IPA	2	2	.00004	.00004
PA	8	10	.00017	.00021

This test to be made with Test #3.

Limit: .002% Change

Signed: M. L. Louner

Date: 9-20-43

TEST #18

Variation of Frequency due to change of tubes.
Under 100% Power key locked condition the average variation of freq. from mean frequency shall not exceed the following for 10 tubes picked at random from tubes within the navy specification.

(a) M.O. Tubes 0.2% (b) I.P.A. Tubes .001%

Tube	MO Freq.	Change in Cps.	IPA Freq.	Change in Cps.
1	2500.075	75	2500.265	15
2	2500.250	750	2500.270	20
3	2500.300	700	2500.265	15
4	2500.200	800	2500.245	5
5	2500.210	790	2500.270	20
6	2500.800	200	2500.270	20
7	2500.200	1200	2500.270	20
8	2501.560	560	2500.265	15
9	2500.500	500	2500.265	15
10	2500.525	475	2500.265	15
Average		650		16
Average Variation		.026 %		.0006%

(Column of variations figured by taking difference between each frequency and average of all ten).

Signed: M. L. Louner

Date: 9-25-43

TEST #19

Operation of rectifier unit with variation in line Frequency.
Line volts 115. R.F. Frequency 2500 KC

SPECIFICATIONS: Satisfactory operations from 50 - 62 cycles.

Line Freq.	Line Tap	Main Rect. Volts	Watts Output
60	2	1275	275
50	2	1290	290
62	2	1280	280

Signed: F. Allen Sherk

Date: 9-22-43

A PART OF NAVY MODEL TCM-TCN-TCU EQUIPMENT

U. S. NAVY CONTRACT SUP.

TEST #20

Check Interlock Satisfactory Date 9-17-43

FILAMENT VOLTAGE CHECK

Rect. Tubes	Volts Across Fil. Meter*	Fil. Voltage
Main	6.2	2.5 Volts
Auxiliary		2.5 Volts

VOLTAGE CONTROL

Line Tap SW	Fil. Control	Fil. Volts	Line Volts	Main Volts	Aux. Volts
1	max. res.	6.3	117	1152	432
1	min. res.	6.3	124	1260	463
2	max. res.	6.3	109	1170	427
2	min. res.	6.3	119	1275	470
3	max. res.	6.3	100	1155	424
3	min. res.	6.3	113	1290	475
4	max. res.	6.3	93	1155	422
4	min. res.	6.3	107	1305	480

POWER CONTROL

Line Tap SW	Power Tap SW	Fil. Volts	Line Volts	Main Volts	Aux. Volts
2	1	6.3	115	570	460
2	2	6.3	115	870	437
2	3	6.3	115	1236	454

PERCENT RIPPLE

Auxiliary rectifier measured .3% Percent Peak

Main rectifier measured .3% Percent Peak

Spec. Max. 1.0%

Operation of other load in receptacle 712 117 V

Operation of receiver receptacle 117 V

*Meter set to 6.3 volts

Signed: Clara Billiar

Date 9-17-43

Character of Emission

TEST #21

C. W. Keying	Satisfactory
M.C.W. Keying	Satisfactory
Phone Voice Mod.	Satisfactory

TEST #22

Oscillogram Record and One Hour Key Test

Oscillogram Taken at 2500 KC

Keying Speed	Oscillogram No.
20 W.P.M. CW	CD -----
20 W.P.M. MCW	CD -----
40 W.P.M. CW	CD -----
40 W.P.M. MCW	CD -----

Operation of antenna relay sequence is satisfactory Yes.

Operation of transmitter for one (1) hour at 12,000 KC with 220 watts C.W. output and keying 40 W.P.M. is satisfactory. Yes

A cathode ray oscilloscope was used to observe modulation on M.C. W. and phone. Yes

Signed: Frank Hill

Date: 9-28-43

TEST #23

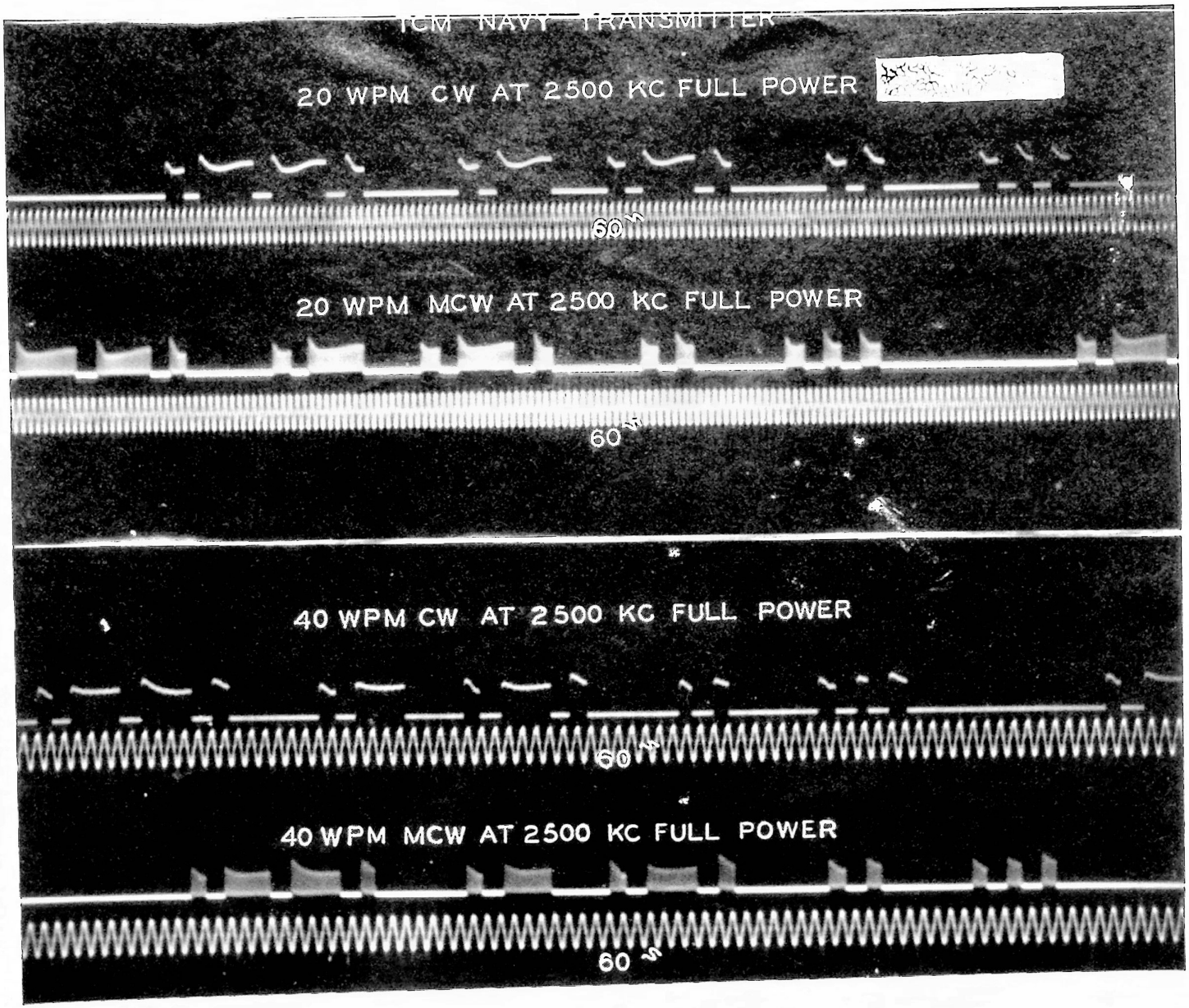
Tube Check

The following tubes were furnished and tested in this equipment

Quantity	Type	Serial No.
4	836	--
4	837	--
2	803	--
Spares		
4	836	--
4	837	--
2	803	--

Signed: Frank Hill

Date: 10-20-43


TCM NAVY TRANSMITTER
20 WPM CW AT 2500 KC FULL POWER
60 ~
20 WPM MCW AT 2500 KC FULL POWER
60 ~
40 WPM CW AT 2500 KC FULL POWER
60 ~
40 WPM MCW AT 2500 KC FULL POWER
60 ~